Protection Action	Benefit to Natal Chinook	Benefit to Other (non-natal) Chinook	Benefit to summer chum, bull trout, other fish
Protect against catastrophic events (many different populations use this sub-basin)		Sustained migration functions for all populations	Sustained migration functions for all species
Protect shoreline protection targets 1,2, 5, and 7-14		Sustained feeding function through forage fish production for all populations	Sustained feeding function through forage fish production for all species
Protect upland sediment sources within shoreline protection targets 3,4 and 6		Sustained feeding, refuge and migratory functions for all populations	Sustained feeding, refuge and migratory functions for all species

Table 6-9. Recommended improvement actions for the San Juan Islands

Improvement Action	Benefit to natal Chinook	Benefit to Other (non-natal) Chinook	Benefit to summer chum, bull trout, other fish
Protect juvenile salmon along shorelines by revisiting or revising the timing of in-water activities (e.g., construction, etc.) later in the calendar year (i.e., juvenile salmon are found to utilize nearshore regions later in the year than previously thought)		Improved growth, migration functions for all populations	Improved growth, migration for all species
Consider wastewater reclamation and reuse retrofits for Friday Harbor, Roche Harbor, Orcas and Rosario wastewater discharges		Improved feeding and refuge functions for all populations	Improved feeding and refuge for all species

6.5 Admiralty Inlet

A. Assessment

In this section we assess salmon and bull trout use, food web and ecological condition, landscape condition, and threats.

1. Salmon Use

Chinook

This is part of the Eastern Strait of Juan de Fuca and Admiralty Inlet region, which includes independent populations in the Dungeness and Elwha river systems but none from the streams draining directly to this sub-basin.

a) Juvenile

- All populations use this sub-basin, especially salmon populations from the main basin of Puget Sound (See Figure 3-1 for a list of all Chinook populations). This sub-basin provides direct support to meeting the Chinook ESU criteria by supporting rearing of juveniles of all populations from all five Geographic Regions of origin.

b) Adult

- Sub-adult and adult salmon from Puget Sound populations utilize habitats within this sub-basin as a passage corridor and grazing area. Chinook are documented to use Gamble Creek and other regions in this sub-basin (See Fig. E-5.1). This sub-basin provides direct support to meeting the Chinook ESU criteria by supporting rearing of sub-adults and adults of all populations from all five Geographic Regions of origin.
- Adult salmon from far outside Puget Sound (e.g., Columbia River and Snake River ESU's) may utilize habitats within this sub-basin as a migratory corridor and foraging area.

Other Listed Species (not comprehensively reviewed or assessed for this sub-basin)

- Chum salmon: Populations of the Hood Canal/Eastern Strait of Juan de Fuca Summer Chum ESU do not emanate from this sub-basin. Non-natal use by populations from Hood Canal/Eastern Strait of Juan de Fuca may occur, but it is not known for certain. Historically, summer chum used Chimacum Creek.
- Bull trout (anadromous): Preliminary core populations (from core areas) within the Puget Sound Management Unit of bull trout do not exist in this sub-basin. It is not known if populations from northern Hood Canal use this sub-basin as forging, migration or overwintering habitat.

2. Ecological and Landscape Conditions

<u>Food Web, Ecological Conditions</u>

Admiralty Inlet is the conduit through which southern populations of Chinook must pass through to reach the Strait of Juan de Fuca. Populations from the Whidbey Basin may also use Admiralty Inlet to reach the Strait of Juan de Fuca, in addition to using Deception Pass to the north. Admiralty Inlet is mostly an open water region with relatively extreme weather and beach action. Deep, dense, saline waters from the ocean and Strait of Juan de Fuca enter Admiralty Inlet and flow south to the Main Basin and north toward Possession Sound and the Whidbey Basin (Ebbesmeyer et al, 2002). Surface currents mostly exit Puget Sound through Admiralty Inlet and then out to the Strait (Ebbesmeyer et al, 2002). This sub-basin is an important place in the Sound

where mixing between oxygen rich waters and outflowing surface waters occurs. Primary and secondary production depends on the right mix of nutrients, light and oxygen. Van Voorhis et al. (2002) reported a pattern of nutrient limitation near the end of summer snow melt, as well as during winter months.

Forage fish are an important component of the diet of outmigrating juveniles and sub-adults in this sub-basin. Pacific herring are found in Kilisut Harbor and the Port Gamble area, and sand lance and surf smelt spawning beaches are found in the same regions, as well as scattered along both east and west shores.

Admiralty Inlet is the major corridor for commercial and recreational vessel traffic in Puget Sound. The potential for oil spills and other contamination would potentially be catastrophic to many salmon populations using this sub-basin as a foraging and migratory corridor to and from the Strait of Juan de Fuca.

Landscape Conditions

In addition to large open water fetches that generate strong wave action, tidal currents are important in shaping nearshore features within this sub-basin. Tall sandy bluffs dominate the shorelines of Admiralty Inlet providing an ample sediment source for beaches, spits and shallow subtidal shelves.

Further depiction of landscape conditions is presented in Appendix E, Figures E-5.1 through E-5.5.

Pocket Estuary Analysis

Our visual analysis of pocket estuaries in this sub-basin revealed 29 pocket estuaries Most are within the southern edge of Port Townsend and Oak Bay/ Kilisut Harbor and the Port Ludlow region (see Fig. E-5.4). Among the results were:

- Freshwater sources were observed in just over one-half the pocket estuaries,
- Based on the assumptions listed in Appendix B, all three of the Chinook functions (feeding, osmoregulation and refuge) were estimated to occur in 13 of the 29 pocket

Overall area

- Total area (deep-water plus nearshore) is 84,864 acres (132.6 square miles).
- Deep-water portion (marine waters landscape class) comprises 63,296 acres (98.9 square miles), or 75% of the total sub-basin area.

Nearshore area

- Nearshore portion comprises 21,568 acres (33.7 square miles), or 25% of the total sub-basin area. A natal estuary (landscape class) is not present in this sub-basin.
- Nearshore area within this sub-basin is 5% of the nearshore area of the entire Puget Sound basin.
- Contains 147 miles of shoreline (beaches landscape class).
- The "key" bays (landscape class) identified in this sub-basin are Port Gamble, Port Ludlow, Mats Mats Bay, Oak Bay, Kilisut Harbor, and Port Townsend.
- Twenty-five linear miles (17%) of the shoreline is designated as marine riparian (defined as the estimated area of length overhanging the intertidal zone).
- In this sub-basin, 67% of the shoreline (99 linear miles) has eelgrass (*Zostera marina* and *Z. japonica*); may be patchy or continuous.
- In this sub-basin, 11% of the shoreline (16 linear miles) has floating kelp; may be patchy or continuous. Also in this sub-basin, 29% of the shoreline (43 linear miles) has non-floating kelp; may be patchy or continuous.

estuaries. Most of the remaining pocket estuaries were estimated to have two of the three Chinook functions,

- Fifteen pocket estuaries were estimated to be *properly functioning*. Five pocket estuaries were estimated to be *not properly functioning*. The remaining pocket estuaries were recorded as *at risk*.

Drift Cell Analysis

There are a number of large, relatively unarmored drift cells within Admiralty Inlet sub-basin. These are regionally important protection targets because of the length of shoreline they occupy and their current condition and function. The drift cell characterization developed for this sub-basin is presented in Appendix E, Figure E-5.5 and subsequent text. Littoral drift, feeder sources, deltaic processes, deposition, and recommendations for protection and restoration are discussed in Appendix E and highlights of recommendations for protection and restoration included in Tables 6-10 and 6-11.

Threats/stressors

Loss and/or simplification of delta and delta wetlands

Natal estuaries for Chinook salmon do not occur in this sub-basin. No information is presented for smaller, non-natal deltas and delta wetlands.

Alteration of flows through major rivers

Larger-scale flow alterations are not present in this sub-basin. Smaller dams and diversions likely exist but are not identified here.

Modification of shorelines by armoring, overwater structures and loss of riparian vegetation/LWD

Shoreline armoring occurs along 17 miles (13%) of the shoreline. Over 11 miles of shoreline are classified as 100% armored. Ninety-nine miles are classified as 0% armored. The total number of overwater structures in this sub-basin is 1,379, consisting of ramps (56), piers and docks (273), small slips (1,032) and large slips (18). Railroads occur along 0.1 miles of shoreline in this sub-basin.

Contamination of nearshore and marine resources

See Figure E-5.3 for a depiction of water quality impairments in this sub-basin.

Alteration of biological populations and communities

There are two fish hatcheries adjacent to this sub-basin. Shellfish aquaculture is distributed mainly within protected embayments like Kilisut Harbor, Oak Bay and Port Gamble.

Transformation of land cover and hydrologic function of small marine discharges via urbanization

Seven pocket estuaries within the sub-basin are currently experiencing stress from urbanization to varying degrees including South Point, Port Ludlow and Chimacum Creek. See Figure E-5.4 for a list of pocket estuaries and noted stressors from visual observation via oblique aerial photos.

Transformation of habitat types and features via colonization by invasive plants

Spartina spp is not found in this sub-basin. Also, 10% of the shoreline (14 miles) contains *Sargassum muticum*, which may be patchy or continuous.

B. Evaluation

In this section we list goals and evaluate the level of realized function for natal and non-natal Chinook, summer chum, and bull trout. From this we then list each of the proposed protection and restoration actions for this sub-basin, and describe the benefits to natal Chinook, non-natal Chinook, and summer chum and bull trout (if any).

Goals for listed salmon and bull trout whose natal streams are in this sub-basin

a) Provide early marine support independent spawning aggregations, including the Chinook documented to occur in Gamble Creek.

Goals for listed salmon and bull trout whos natal streams are outside this sub-basin

a) Provide support/use for all populations using this sub-basin, especially main basin Chinook populations. This area is a bottleneck, and for populations from the Stillaguamish, Snohomish and Skagit, this is the principle corridor to reach the Pacific Ocean via the Strait of Juan de Fuca. Fewer fish are thought to use Deception Pass as a corridor.
b) Chum salmon use of this area is not sufficiently known, although some historic use did occur in one stream approximately 20 years ago.
c) Fish in this sub-basin are not necessarily of small size; therefore the fish are not necessarily tied to shallow water habitats. Adequate water quality is critical to salmon in this sub-basin
d) Provide for connectivity of habitats; also, adequate prey resources, marine foraging areas, and migratory corridors for sub-adult and adult Chinook.

Realized function for listed salmon and bull trout

Fry migrant and delta fry Chinook – More than 50% of the pocket estuaries support conditions favorable to this life history type, most of these situated on the western shores of Admiralty Inlet and along areas with protected shorelines (Figures E-5.1 and E-5.2), and many in areas near eelgrass (i.e., continuous bands). However, the pocket estuaries and nearshore habitats of this sub-basin are a great distance from natal estuaries of independent Chinook populations (much greater than 10 miles) and are likely only important for support of this life history type from local independent spawning aggregations.

The west side of Admiralty inlet (North Kitsap Peninsula) is more likely to support early migrant Hood Canal/Eastern Strait of Juan de Fuca Summer chum from Northern Hood Canal rivers and which may ultimately extend significantly south into the Central Puget Sound Sub-basin toward Kingston. The east side of Admiralty Inlet (West Whidbey Island) is more likely to support larger life history types of all populations of both Chinook and Hood Canal/Eastern Strait of Juan de Fuca Summer chum.

Parr migrant Chinook – Many of the Puget Sound Chinook salmon migrate to the ocean as sub-yearlings (Myers et. al., 1998), and on average this life history type is the most abundant in Puget Sound. By the time Chinook and Hood Canal/Eastern Strait of Juan de Fuca Summer chum salmon are the size of parr migrants (approximately >70 mm), the Admiralty Inlet sub-basin is realized as a critical nexus in Puget Sound. Most of the 22 independent populations of Chinook salmon, and all the Hood Canal/Eastern Strait of Juan de Fuca Summer chum salmon must pass through Admiralty Inlet to reach the Strait of Juan de Fuca en route to the Pacific Ocean for maturation. Any type of catastrophic event (e.g., oil spill) would significantly affect most if not all ESA-listed salmon populations within Puget Sound. Guarding against such an event is a critical step to safeguarding populations as they emigrate to the Pacific Ocean.

In addition to being the main conduit for salmon populations, salmon the size of a parr migrant derives functions (e.g., rearing, foraging, refuge) from habitats within the nearshore. The west and south side of Admiralty Inlet contains most of the sub-basin's pocket estuaries (functioning,

at risk and some not functioning), protected shorelines and eelgrass bands. Along the western shore, parr migrants coming from Hood Canal, Whidbey Basin and central and south sound must also contend with two sewage outfalls and a region of low dissolved oxygen near the Hood Canal Bridge and also in Port Gamble.

Yearling Chinook – Any reduction in capacity as a result of non-support of the other life history types (i.e., primarily parr migrant and possibly delta fry) within this sub-basin will negatively affect yearling migrants. As with the parr migrants, yearlings must also pass through Admiralty Inlet to the Strait of Juan de Fuca en route to the Pacific Ocean and any catastrophic event would be disastrous to salmon populations. Yearlings emigrating from Hood Canal, central and south sound, and the Whidbey Basin can derive function (e.g., foraging, refuge, migratory pathway) from the relatively unarmored shorelines with sparse overwater structure, as well as accessing the functioning (and at risk) pocket estuaries and protected shoreline regions.

Sub-adult and adult Chinook – We hypothesize that the survival of sub-adult and adult Chinook salmon is likely dependent on the production and availability of forage fish species within nearshore regions of this sub-basin. In addition, marine vegetation such as eelgrass and kelp play an important role in salmon survival. An uncontaminated migratory corridor is critical to survival of the majority of Chinook populations in Puget Sound that must pass through this region.

Summer Chum – Hood Canal/Eastern Strait of Juan de Fuca summer chum salmon use the western shore of this sub-basin as outmigrant fry (Simenstad 2000a).

Bull Trout – We hypothesize that anadromous bull trout do not use this sub-basin

Table 6-10. Recommended protection actions for Admiralty Inlet

Protection Action	Benefit to Natal Chinook	Benefit to Other (non-natal) Chinook	Benefit to summer chum, bull trout, other fish
Aggressively protect all drift cell function that supports eelgrass bands and depositional features throughout the sub-basin. Consider designating these shorelines for the highest level of protection within county shoreline master programs and critical areas ordinances and pass strong policies limiting increased armoring of these shorelines. (Shoreline protection targets 1-6, 8,9,11,13 on Fig. E-5.5, Appendix E)		Sustained feeding function through forage fish production for all populations	Sustained feeding function through forage fish production for all species
Protect against catastrophic events		Sustained migration functions for all populations	Sustained migration functions for all species

Table 6-11. Recommended improvement actions for Admiralty Inlet

Improvement Action	Benefit to natal Chinook	Benefit to Other (non-natal) Chinook	Benefit to summer chum, bull trout, other fish
Restore drift cell functions in shoreline restoration targets 7,10,12 and 14 in Fig. E-5.5		Improved feeding function through forage fish production for all populations	Improved feeding function through forage fish production for all species

6.6 Whidbey Basin

1. Salmon Use

Chinook

This is part of the Whidbey Basin and Padilla and Samish bays region, which includes 10 of the 22 independent populations of Chinook within the Puget Sound ESU. Each of the independent populations in this region emanate from this sub-basin:

- Lower Skagit
- Upper Skagit
- Cascade
- North Fork Stillaguamish
- South Fork/Mainstem Stillaguamish
- Suiattle
- Lower Sauk
- Upper Sauk
- Skykomish
- Snoqualimie

a) Juvenile

- Juvenile Chinook salmon of all four life history types for all 10 natal populations utilize this sub-basin for feeding and growth, refuge, physiological transition and as a migratory corridor (juvenile salmon functions).
- Juvenile Chinook salmon from neighboring populations utilize this sub-basin for feeding and growth, refuge, physiological transition and as a migratory corridor.

b) Adult

- Sub-adult and adult salmon from Puget Sound populations utilize habitats within this sub-basin as a migratory corridor and grazing area.

Other Listed Species (not comprehensively reviewed or assessed for this sub-basin)

- Chum salmon: Natal populations of the Hood Canal/Eastern Strait of Juan de Fuca Summer Chum ESU do not exist in this sub-basin. Non-natal use may occur, but it is not known for certain.